SCIENTISTS AND THEIR SPECIALTIES

Beltsville
Human Nutrition Research Center
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Mission: (1) To conduct research relevant to human requirements for energy, protein, carbohydrates, lipids, vitamins and minerals and their bioavailability from commonly eaten foods which will assure optimal function throughout the life cycle. (2) Development of dietary strategies which can lead to postponement of the onset of nutritionally-related debilitating diseases. In carrying out this twofold mission small laboratory animal models are developed and utilized for determination of design and performance of human studies. Animal studies are used to establish new hypotheses, test existing ones and to clarify basic metabolic function of nutrients. Controlled human dietary-metabolic studies are used as the experimental tests upon which can be developed dietary strategies for a healthy Nation and guidance for improving the nutritional quality of food crops and animals.

Office of the Center Director and Human Study Facility
Beltsville Human Nutrition Research Center
Beltsville, MD 20705

Mission: The Office of Center Director provides for coordination, evaluation and safety of all nutritional studies involving human subjects and for the rapid application to human studies of knowledge concerning nutrient bioavailability and interactions; metabolic mechanisms of action; and nutrient requirements which were developed through studies using animal models.

Dr. Walter Mertz, Director Room 223, Building 308 Beltsville, Maryland 20705 301/344-2157	Provides leadership to the Center. Studies health-related problems relating to nutriture of trace elements.
Dr. Helene N. Guttman Associate Director Room 224, Building 308 Beltsville, Maryland 20705 301/344-1627	Provides coordination and strategic planning to the Center. Studies relationship of bio-availability of trace nutrient requirements to human productivity. Interpretation of fundamental science and science policy to lay agencies.
Priscilla D. Steele Chief Dietician Room 326, Building 308 Beltsville, Maryland 20705 301/344-2411	Provides leadership to the Human Study Facility.

Carbohydrate Nutrition Laboratory
Beltsville Human Nutrition Research Center
Beltsville, Maryland 20705

Mission: To (1) determine the effects of utilizable carbohydrates such as sucrose, fructose and starch on the levels of metabolic risk factors associated with human disease and investigate the mechanisms for their differential metabolic effects; (2) determine the effects of nonutilizable carbohydrates (i.e., dietary fiber) on metabolic processes and nutrient bioavailability and to investigate the mechanisms underlying these effects; (3) determine the nature of metabolic interactions that occur between dietary carbohydrates and other dietary components; and (4) determine the effects of these carbohydrates and interactions on population groups with different genetic predisposition (e.g., carbohydrate-sensitivity) in order to identify those individuals at particular risk from various dietary carbohydrates. The information to be derived from these studies will enable the laboratory to attain its technical objective, the establishment of requirements for carbohydrate intake by humans and the forms of these nutrients in food that best meet these requirements, and, in doing so, improve the health and quality of life in the adult and aging population.

Dr. Sheldon Reiser Research Leader Supervisory Research Chemist Room 315, Building 307 Beltsville, Maryland 20705 301/344-2396	Provides leadership to the Laboratory. Studies the effect of dietary carbohydrates on metabolic risk factors associated with diseases such as heart disease and diabetes in experimental animals and humans. Interactions between carbohydrates and other nutrients. Metabolic characterization of carbohydrate-sensitivity.
Dr. Kay M. Behall Research Nutritionist Room 304, Building 307 Beltsville, Maryland 20705 301/344-2385	Studies the effects of chemically-defined dietary fiber on metabolic and physiological processes associated with heart disease, diabetes, bowel function and mineral balance in humans. Effect of different sources of starch or fiber on metabolic risk factors associated with human diseases.
Dr. Sam. J. Bhathena Research Chemist Room 311, Building 307 Beltsville, Maryland 20705 301/344-2422	Studies the effects of dietary carbohydrate on tissue receptors of hormones such as insulin in experimental animals and human subjects. Role of opiates in diabetes and obesity in experimental animals and humans.
Dr. June L. Kelsay Research Nutritionist Room 302, Building 307 Beltsville, Maryland 20705 301/344-2417	Determines the level and kind of dietary fiber consumed by people with different dietary habits (e.g., vegetarians) and how adaptation to these diets influence mineral balance, blood lipids, glucose tolerance and nutrient utilization.

Dr. Otho E. Michaelis IV
Research Nutrition Scientist
Room 317, Building 307
Beltsville, Maryland 20705
301/344-2093

Studies the effects of feeding various carbohydrates to experimental animals with specific genetic predisposition toward obesity, hypertension, glucose intolerance and how diet and genetics interact to produce metabolic defects.

Dr. Bela Szepesi
Research Chemist
Room 313, Building 307
Beltsville, Maryland 20705
301/344-2489

Studies basic mechanisms by which dietary carbohydrates can differentially influence obesity and glucose tolerance. Isolation, purificat and characterization of enzymes converting carbohydrate to fat.

Dr. David L. Trout
Research Nutritionist
Room 328, Building 307
Beltsville, Maryland 20705

Studies gastrointestinal responses to dietary carbohydrates. Effects of carbohydrates on gastric emptying, digestion, absorption and secretion of gastrointestinal hormones.

Energy and Protein Nutrition Laboratory
Beltsville Human Nutrition Research Center
Beltsville, Maryland 20705

Mission: (1) To determine human energy requirements as modulated by dietary factors and energy expenditures; (2) to ascertain metabolic responses to proteins and minerals and their interaction; and (3) to examine the changes in fermented milk products to determine how these changes affect nutritional value.

Dr. Paul W. Moe Research Leader Supervisory Res. Physiologist Room 214, Building 308 Beltsville, Maryland 20705 301/344-2059	Provides leadership to the laboratory. Development of calorimetry facilities. Adequacy of Atwater factors in human diets. Effects of diet composition on diet induced thermogenesis. Sources of variation in energry of humans.
Dr. C. E. Bodwell Supervisory Research Chemist Room 214, Building 308 Beltsville, Maryland 20705 301/344-2203	Assessment of possible adaptation effects in humans which result from long-term alterations in energy intake. Interrelationships between protein and energy metabolism. Methods for assessing protein nutritional quality for humans.
Dr. Joan M. Conway Room 318, Building 308 Beltsville, Maryland 20705 301/344-2977	Studies newer methods of estimating body composition Research Chemist in humans. These methods include near-infrared interactance and total-body impedance. Utilization of stable isotopes for studying amino acid and energy metabolism, and indirect calorimetry for studying energy expenditure.
Dr. Anthony D. Hitchins Research Microbiologist Room 106, Building 157 Beltsville, Maryland 20705 301/344-4350	Research concerns novel microbiological methods for estimating amino acid bioavability.
Dr. Juliette C. Howe Research Chemist Room 201, Building 308 Beltsville, Maryland 20705 301/344-2181	Studies the effects of varying protein intake (level and/or source) on postprandial calcium and phosphorus metabolism in postmenopausal women, a population at risk to developing osteoporosis. physiological bases of varitation among individuals in resting energy expenditure.
Dr. Florence Lazicki Research Chemist Room 201, Building 308 Beltsville, Maryland 20705 301/344-2161	Research includes the assessment of bone status, whole body composition (calcium, phosphorus, nitrogen, sodium, chloride, potassium and water), and balance in relationship to self-selected dietary habits of premenopausal and post menopausal women.

Frank E. McDonough Research Food Technologist Room 205, Building 157 Beltsville, Maryland 20705 301/344-4351	Studies relate to protein nutritional quality for humans with an objective of developing a rapid in in vitro method for assessing protein quality based on amino acid composition, digestibility and bioavailability.
Dr. Carolyn W. Miles Research Chemist Room 212, Building 308 Beltsville, Maryland 20705 301/344-2127	Studies variation in energy expenditure in adults as a function of ingestion of diets which differ with respect to their major components (protein, fat and carbohydrate). Experimentally testing of the accuracy of currently used "standard"values for the caloric content of foods derived by mathematical calculation from formulas (Atwater method) rather than actual measurement.
Dr. William V. Rumpler Research Associate Room 317, Building 308 Beltsville, Maryland 20705 301/344-4207	Effects of diet composition, plans of nutrition and environmental factors influencing energy in animal model systems and human subjects using directo and indirect calorimetry facilities.
Dr. James L. Seale Research Biomedical Engineer Room 317, Building 308 Beltsville, Maryland 20705 301/344-4207	Development and calibration of direct and indirect calorimetry equipment. Energy cost of physical activity. Metabolic source of nutrient supply during exercise. Development and validation of stable isotope method for estimating energy expenditure in free living populations.
Eugene R. Wiley Research Chemist Room 217, Building 308 Beltsville, Maryland 20705 301/344-2120	Assesses energy expenditure in adults consuming diets which maintain body weight but vary with regard to proportion of protein, fat and carbohydrate. Studies the effects of composition and aging on the metabolism of collagen in structural tissues and the relationship to osteoporosis and other age. Induced conditions using an animal model system.
Dr. Noble P. Wong Research Chemist Room 203, Building 308 Beltsville, Maryland 20705 301/344-4588	Current research involves the determination of dietary fiber content of food to identify and quantitate those components associated with physiological function. Develops and determines the adequacy of methods and measures dietary fiber as defined.

Lipid Nutrition Laboratory
Beltsville Human Nutrition Research Center
Beltsville, Maryland 20705

Mission: Determine effects of both kind and amount of dietary fat on metabolic and related physiological parameters in humans so that recommendations on optimal intake of fat and its constituent fatty acids are consistent with life-long maintenance of good health without adversely affecting quality of life.

Lack of knowledge of how other macro nutrients and non-nutritive components of the diet interact with lipids limits our ability to predict how different intake patterns will affect an individual. A major deficit in our understanding is how the relative amounts of the macro nutrients in the diet affect micro nutrient requirements for people of different ages. We also do not know how nutrient balance in foods or mixed diets affects bioavailability of micro nutrients.

The laboratory pursues this mission using free-living human volunteers and experimental animal models to: (1) investigate needs for essential fatty acids under different physiological conditions; (2) investigate the bioavailability of vitamins involved in lipid metabolism; and (3) investigate dietary lipid and cholesterol effects on physiological parameters related to good health.

Dr. Joseph T. Judd Research Leader Supervisory Research Chemist Room 126A, Building 308 Beltsville, Maryland 20705 301/344-2014	Provides leadership to the laboratory. Current research includes investigating the role of lipids in the human diet in areas of critical importance to human health and well being.
Dr. Elliott Berlin Research Chemist Room 109, Building 308 Beltsville, Maryland 20705 301/344-2297	Investigates the influences of dietary lipids on the composition and physical properties of circulating lipoproteins and membranes of blood cells potentially involved in cardiovascular diseases. Studies the relationships of lipoprotein and membrane lipid composition to fluidity and the effects of fluidity on physiological properties of membranes such as receptor activity and platelet aggregation.
Dr. Aldo Ferretti Research Chemist Room 122, Building 308 Beltsville, Maryland 20705 301/344-2171	Studies the roles of dietary lipids in human physiology and health by investigating the effect of their intake on prostaglandin biosynthesis. Specifically responsible for research on the composition, structure, identity and occurrence of cyclooxygenase and lipoxygenase metabolites of polyunsaturated fatty acids in selected tissues and biological fluids.

Mary W. Marshall
Research Nutritionist
Room 115, Building 308
Beltsville, Maryland 20705
301/344-2156

Project leader for biotin nutrition studies and co-team leader for lipid nutrition studies. The overall goal of the research is to find the level of dietary essential fatty acids (EFA) that is best to maintain optimal health, to prevent diseases such as atherosclerosis, thrombosis and hypertension.

Dr. Padmanabhan P. Nair
Research Chemist
Room 113, Building 308
Beltsville, Maryland 20705
301/344-2583

Conducts research on dietary lipids and their influence on human health, especially as related to dietary factors and the causation and/or prevention of cancer; and also the role of nutrition in delaying the process of aging, with special reference to the susceptibility to carcinogenesis. Determines relationship of dietary fat and other nutrients to age-related disorders as reflected by changes in sterol and bile acid metabolism, fecal mutagenesis and glutathione sulfotransferase.

Dr. Norberta W. Schoene
Research Chemist
Room 111, Building 308
Beltsville, Maryland 20705
301/344-2388

Investigates the relationship between essential fatty metabolism and prostaglandin production. Utilizes intact cells, especially blood platelets, to study the influences of diet on alterations in the production of these hormone-like lipids derived from essential fatty acids. Investigates the effects of dietary nutrients on cellular responses modulated by prostaglandins, e.g., platelet aggregation.

Nutrient Composition Laboratory
Beltsville Human Nutrition Research Center
Beltsville, Maryland 20705

Mission: Provide essential data on the nutrient content of foods as consumed in the U.S. This mission shall be accomplished by: (1) analyzing the nutrient content of foods with tested dependable assay techniques and supplying the results of these analyses to appropriate groups and agencies, (2) designing and developing either new or improved methodologies for the analysis of nutrients in foods by conducting appropriate research in chemistry, biochemistry and biology, (3) developing and utilising sound sampling techniques for the U.S. food supply to ensure that representative samples are analyzed for their nutrient content, (4) transferring new technologies to industrial, academic and government laboratories both in the United States and world wide.

Dr Gary R. Beecher Research Leader Supervisory Research Chemist Room 102, Building 161 Beltsville, Maryland 20705 301/344-2356	Research leader of the laboratory. Coordinates research activities of the laboratory with research in other organizations including other USDA laboratories, NIH, FDA universities and international organizations. Develops methodologies and measurement systems to quantify carotenoids in foods and diets. Designs and develops instrumentation, such as flow injection analyzers, chromatographic systems and automated extraction equipment, to accomplish new methodologies.
Dr. Robert F. Doherty Chemist Room 216A, Building 161 Beltsville, Maryland 20705 301/344-2157	Designs, develops, and implements within-laboratory computer systems. Develops systems for unified data collection ranging from direct instrument interface to manual data input. Develops and maintains complex software such as statistical, chemometric, word processing and laboratory data management packages.
Dr. James M. Harnly Research Chemist Room 2, Building 161 Beltsville, Maryland 20705 301/344-2569	Develops high volume, high accuracy applications of a simultaneous multielement atomic absorption spectrometer. Analysis of trace metals in foods. Application of automated data processing, statistical evaluation, and noise source evaluation to instrumental methods.
Joanne Holden Nutritionist Room 116, Building 161 Beltsville, Maryland 20705 301/344-2933	Designs, develops and implements a statistically based sampling strategy which serves as the basis for selection of food samples to be analyzed. Coordinates food sample preparation to ensure that subsequent nutrient composition of food analyses will reflect the Nation's food supply. Prepares data for dessmination to other laboratories and agencies, liaison between scientist, user of the data and representatives of other agencies especially

	concerning the sources and magnitude of variability in the nutrient composition of foods
Dr. Betty W. Li Research Chemist Room 105B, Building 161 Beltsville, Maryland 20705 301/344-2466	Develops accurate, high volume methods for carbohydrate analyses; especially sugars and starch determinations using gas-liquid chromatographic techniques. Develops reliable methods for the analysis of dietary fiber, e.g. hemicellulose, pectins and gums.
Dr. Nancy Miller-Ihli Research Chemist Room 2, Building 161 Beltsville, Maryland 20705 301/344-2054	Develops electrothermal atomization methods for use with a prototype simultaneous multielement atomic absorption spectrometer. Sample preparation and presentation for trace metal analysis of biological materials. Development of solid and slurry sampling techniques. Development of computer software.
Dr. Raymond Thompson Research Chemist Room 200, Building 161 Beltsville, Maryland 20705 301/344-2314	Develops, improves and validates quantitative analytical chemical methodology for analysis of lipid nutrients in foods; designs and implements computer database applications for data evaluation and reporting in nutrient composition research; develops multivariate numerical methods to enhance information extracted from nutrient data bases.
Dr. Joseph T. Vanderslice Research Chemist Room. 3, Building 161 Beltsville, Maryland 20705 301/344-2370	Determines vitamins in food and food extracts by high performance liquid chromatography; special emphasis is placed on developing extraction procedures which yield full vitamin recovery without destruction of any vitamin forms and which separate vitamins from possible interfering compounds. Of particular interest at present are vitamins B-6, C and thiamine. Theoretical treatment of flow injection analysis: 1) to enable prediction and design of experimental systems, and 2) to determine molecular parameters such as diffusion coefficients and reaction rate constants.
Dr. Wayne R. Wolf Research Chemist Room 8, Building 161 Beltsville, Maryland 20705 301/344-2927	Coordinates laboratory program for development of appropriate food/biological reference materials characterized for nutrient content. These materials are for in-house projects and also in improving world-wide compatibility of nutrient measurements. Develops sensitive, accurate methods for analysis of inorganic nutrient content of food and other biological material. Utilization of spectroscopic and combined chromatographic-spectroscopic techniques for chemical speciation of the trace elements.

Vitamin and Mineral Nutrition Laboratory
Beltsville Human Nutrition Research Center
Beltsville, Maryland 20705

Mission: Determine human requirements and basic mechanisms of action for specific vitamins and minerals. Identify chemical forms and bioavailability of vitamins and minerals in foods consumed by humans. Develop sophisticated analytical instrumentation and techniques for assessment of trace elements and vitamins in human nutrition.

Dr. James C. Smith, Jr.
Research Leader
Supervisory Research Chemist
Room 215, Building 307
Beltsville, Maryland 20705
301/344-2022

Provides leadership to the laboratory. Investigates metabolism of zinc, copper and vitamin A in animal models and humans. Assesses methods for determining nutritional status for trace elements and vitamin A and studies specific nutrient interactions, such as vitamin A and zinc; copper-carbohydrates.

Dr. Richard A. Anderson
Research Chemist
Room 224, Building 307
Beltsville, Maryland 20705
301/344-2091

Conducts research on the effects (especially on carbohydrate metabolism and human performance) of consuming average American diets (which are marginally adequate in chromium) compared with effects of consuming diets which contain the suggested, higher, amount of chromium. Adequate dietary chromium is associated with a decrease in risk for cardiovascular disease and diabetes.

Rex Ellis
Research Chemist
Room 206, Building 307
Beltsville, Maryland 20705
301/344-2282

Studies the phytate: zinc molar ratios of self-chosen diets in general and vegetarian groups as indices of bioavailability of the zinc in these diets; evaluates methods for measuring phytate.

Dr. Mark Failla
Research Microbiologist
Room 205, Building 307
Beltsville, Maryland 20705
301/344-2148

Investigates various aspects of copper, iron and zinc metabolism at the cellular and molecular levels in animal models. Emphasis is placed on the development and use of biochemical and immunological probes for elucidating the basis of interactions between nutrients (e.g., copper-carbohydrate and copper-iron interactions) and assessing trace metal status. The impact of physiological factors such as stress, hormones and age on the metabolism of these trace metals also is studied.

Dr. Orville A. Levander
Reserch Chemist
Room 220B, Building 308
Beltsville, Maryland 20705
301/344-2504

Investigates the role of selenium, and vitamin E, in human nutrition as can be clarified through studies on the functions and biochemical mode of action of selenium and vitamin E and their interrelationships. Other studies on the physiological need for these two nutrients aim at determining the requirements under different conditions (for example stress) and development of accurate methods for assessing their status in humans.

Dr. Eugene Morris
Research Chemist
Room 206, Building 307
Beltsville, Maryland 20705
301/344-2282

Investigates the effect of wheat bran in the diet of humans on bioavailability of iron, zinc and other mineral nutrients. Specific problems addressed are the interaction of phytate and dietary fiber of the bran and the effect of overall diet composition on bioavailability.

Dr. Robert D. Reynolds
Research Chemist
Room 217, Building 307
Beltsville, Maryland 20705
301/344-2459

Investigates the metabolism of, and requirements in premature infants, and lactating women for, vitamin B-6 in normal healthy adults, and people with asthma, sickle cell anemia, or post heart attack. Determines the effects of intakes of vitamin B-6 glycoside by lactating women and its effects upon them and their breast-fed infants.

Dr. Claude Veillon
Research Chemist
Room 226A, Building 307
Beltsville, Maryland 20705
301/344-2010

Studies metabolism of trace elements (particularly chromium and selenium) required for human nutrition and develops new accurate and precise methodologies for determination of trace elements in biological materials. Special attention is given to development of methods for measuring stable isotopes and their use in in vivo tracer studies in human and elucidating means of measuring trace element status and requirements in humans.

RECENT RESEARCH ACCOMPLISHMENTS

All Starches Are Not Metabolically Identical

There are two main categories of starch based upon the organization of the complex structures of these polysaccharide carbohydrates. Therefore we are studying the effect of supplying dietary starch as (a) starch which is 70% amylose compared with (b) a starch which is 70% amylopectin. In both cases, 34% dietary calories were from starch. Although only some types of analyses have been completed, it is already clear that people metabolize these two structural types of starch differently. In the analyses completed thus far these difference have been shown: The amylose diet led to significaty lower blood triglycerides, and lower summed insulin levels. Both glucose and insulin levels were lower up till two hours after meals follows by a significantly higher glucose level 3-4 hours after meals. No significant differences were observed on glucose tolerance tests.

Digestive System Response to Feeding Xanthan, A Viscous Polysaccharide

Xanthan gum is highly viscous, pure and usually resistant to break down in the digestive tract. In the rat model, xanthan slows gastric emptying, increases distention of the small intestine and shifts towards the lower part of that intestine, unabsorbed nutrient. Xanthan also slows nutrient inflow to body tissues and alters neural and hormonal signals from the intestine.

Xanthan Gum Lowers Blood Glucose in Non-Insulin Dependent Diabetes

Xanthan, fed in biscuits to newly-diagnosed non-insulin dependent diabetics, significantly lowered blood glucose. Except for the xanthan-biscuits, the diet was mainly self selected. Xanthan is a natural product: a polysaccharide coating of a microoganism which can be grown economically and rapidly in large quantity. The xanthan can be obtained as a highly purified product. Xanthan biscuits or other products would find a market among non-insulin dependent diabetics.

New Animal Model for Type II (Insulin Independent) Diabetes

The genetically obese rat SHR/N-Corpulent, a recently developed strain, was shown to be a good model to study metabolic effects of dietary carbohydrate on type II diabetes. These rats, but not their lean littermates, have elevated serum insulin levels. Their hyperinsulinema was aggrevated by diets in which the carbohydrate was sucrose (but not by starch). Sucrose-fed (but not starch-fed) corpulent rats developed elevated serum triglycerides and were hyperglycemic following an oral glucose tolerance test. Finally, these rats exhibited morphological changes charactertic of diabetes such as pancreatic islet cell hyperplasia, hepatic lipidosis and glomerular nephropathy.

Impaired Glucagon Activity in Genetic Obesity

Three genetically different obese (LA/N-corpulant, Zucker, and SHR/N-corpulant) rat models were used to explore causes of genetic obesity. In humans, genetic obesity is characterized by hyperlipemia and mild hyperglycemia. Futhermore, dietary surcose is more lipogenic than dietary starch. In the animal models, compared with their lean littermates, the following were observed: higher plasma levels of glucose, triglycerides, and insulin, lower binding of glucagon and insulin to liver plasma membranes. The decreased insulin binding was due to decrease in the number of receptors and decreased affinity, while decreased glucagon binding was only due to a decrease in receptor number. Dietary sucrose lowered insulin binding in all three models but it only decreased glucagon binding in LA/N-corpulent and SHR/N-corpulent (but not Zucker) rats. Plasma glucagon levels were the same in lean and compulent rats, thus suggesting a failure of glucagon receptors to respond to plasma glucagon levels in genetic obesity and further suggesting that this type of impaired glucagon activity may be an important contributor to the hyperlipemia and hyperglycemia of genetic obesity.

Effeciency of Conversion of Dietary Disaccharides to Body Fat

Using an animal model (adult male rats) we showed that inclusion of disaccharides such as sucrose or maltose improve the conversion of food to energy and body fat under conditions where food effeciency had been low but had no effect on conversion effeciency where conversion efficiency was already high (e.g. repletion of body weight after severe weight loss). The effect of disaccharides on female rats is less striking because they exhibit somewhat higher food effeciency than male rats of comparable age.

Patterns in Gastric Emptying in an Animal Model

In the rat, circadian rhythmicity for gastric emptying (a) can be modulated by the eating pattern, (b) was associated with rhythmicity of autonomic nervous system function. These data, and future studies will be used to help predict the best pattern and frequency for people to eat starches, sugars and fiber so that they can get the most benefit from these nutrients. For people, an additional factor must inserted - the suggestions must be compatible with their life styles.

Gender Linkage for Carbohydrate Inducers of Rat Liver NADP-linked Dehydrogenases

In wealing rats of either sex the disaccharide effect is very small or nonexistent. However in adult males there is a disaccharide effect due to the presence of male sex hormones: surgically altered males have a lower response to disaccharides while surgically altered females have a higher response. The Zucker obsese female has an augmented response to disaccharides because of its lower than usual female hormone levels.

Young Pig Model for Human Nutrition

The similarities between cardiac and gastrointestinal architechture, as well as ethical constraints limiting human experimentation, led to development of the young pig model. Experiments with young male pigs showed that animals fed fructose (but not glucose) to supply 20% of their daily caloric needs and which also were copper dificient (but not copper sufficient) displayed severe cardiac hypertrophy, elevated cardiac tissue iron and zinc, reduced superoxide dismutase and ceruloplasmin activities, reduced aortic and tissue lysyl oxidase activities and myocyte aberrations. All of these conditions were reversed by either copper supplementation or substitution of glucose for dietary fructose.

Bioavailability of Selenium

In experiments with laying hens, it was found that organically-bound forms of selenium (yeast or selenomethionine) concentrated in egg to a greater extent than did inorganic forms of selenium (selenite). This finding suggests a rapid means of speciation of selenium in dietary sources, a benefit to improving our scant knowledge regarding forms of selenium in foods.

Biopotency of D-and L-forms of Organic Selenium In An Animal Model

Experiments with rats showed that D-and L-selenomethionine had similar curves for biopotency, including the point at which large doses become toxic. Confirmation of these findings with humans remain to be done. Thus the racemate, which is much cheaper than the optically resolved forms, may be a useful product for human nutritional supplementation.

Absorption Differences Between Forms of Selenium

Human studies with stable isotopes showed that L-selenomethionine is better absorbed that selenite and is therefore the compound of choice for raising selenium status in depleted individuals.

Epidemiological Survey of Human Selenium Toxicity in China

Ten localities in the selenferous area of Enshi County in China were studied. Preliminary analysis of data indicated no pronounced symptoms of selenosis with the possible exception of three (out of a total of more than 600 subjects) with deformed nails and partial loss of hair.

Development of Methods and Analyses of Selenium in Foods

A collaborative program (with HNIS/USDA) aims at improving data on the selenium content of foods. Foods selected for sampling are based upon both the availability of good quality analytical data and the amount selenium that a particular food contributes to the diet of Americans. General sampling plans were developed for the selection of a large number of foods in a few cities in the United States. Detailed sampling plans were established to assess the variability of selenium in bread, cottage cheese, eggs and steak.

Measuring Selenium Status in Humans

Masurements of selenium status which accurately reflect changes in selenium intakes are necessary if supplements are to be given to humans for potential cancer prevention. Whole blood selenium levels appear to be such measurements as shown in studies from seleniferous areas of South Dakota.

Pharmacokinetic Model for Studying Human Selenite Metabolism

A model developed in humans, includes measurement of the following components: absorption along the gastrointestinal tract; four plasma components; a subsystem consisting of the liver and pancreas; and a slowly turning over tissue pool.

Expert System for Selenium Foods

A computerized expert system was developed to evaluate published data on selenium in foods.

Changes in Platelet Aggregation in Selenium Deficient Rats

Selenium deficiency causes decrease in activity of the selenium-containing enzyme glutathione peroxidase (an intracelluar scavenger of toxic peroxides). These peroxides differentally affect the activity of enzymes which influence formation of clots. That is, platelets from selenium deficient rats clotted to a greater extent than normal. Also heart artery (aorta) tissue from the deficient rats had impaired ability to produce a prostacyclin-like material. Type of dietary fat influenced production of the prostacyclin-like material in both normal and selenium deficient animals.

Phytate, Fiber and Mineral Bioavailability (iron, zinc and calcium)

Phytate is a mineral binding component bran-type fiber. For people eating an omnivorous diet, unless high levels of bran is consumed, there is no adverse effect on mineral nutrition. However in a study in which about 24g of wheat bran/day were consumed by health adult males, both calcium and iron balances were negatively affected. Relatively high intakes of calcium overcame the adverse effect of bran on calcium bioavailability. However decreased iron and zinc balances were noted in calcium-supplemented subjects. Thus nutritionists should pay special attention to mineral balancing and/or consider using brans with phytate levels reduced for people on sustained high bran diets.

Iron Supplementaion and Zinc Status of Pregnant Women

Previously we showed an inverse correlation between plasma zinc and the level of iron supplementation. The object of the present study was to determine whether acute changes in zinc status could be detected after initation of iron therapy during pregnancy. A mean plasma decline of 3.9+7.8g/dl was observed in a week without further decline during the next four weeks. Changes in plasma zinc were not correlated with level of iron therapy or changes in iron status. Thus, iron therapy in a dose range typical in prenatal care has an acute effect on maternal zinc status.

Sex Differences in Response Limiting Copper

High fructose diets in the presence of limiting copper leads to increased mortality due to severe cardiovascular abnormalities in male but not female rats. The females exhibit adverse changes in serum lipid but the effects are not deadly. These results suggest that, when consuming a diet high in fructose, men may have have higher copper requirement women.

Source of Dietary Carbohydrate Modifies Immuoresponsive of Moderately Copper Deficient Rats.

Copper deficient male rats are very sensitive to the source of their dietary carbohydrate: fructose but not starch leads to premature death due to failure of the cardiovascular system. We now show that a similar sensitivity exists in the immune system. Hemagglutination titers were normal in rats fed adequate copper, regardless of carbohydrate source. Rats moderately deficient in copper which were then fed fructose showed only neglegible immune response (1-6%) while those fed starch produced appoximately half normal antibody titers.

Effect of insulinogenic Carbohydrates on Chromium Excretion

Urinary chromium losses in both male and female subjects varied according to the insulinogenic properties of the carbohydrate fed. Thus the most insulinogenic (glucose plus fructose) elicited the highest chromium excretion = 22.4 ng/ml; followed by glucose alone = 17.3 ng/ml; followed by starch plus fructose = 13.8 ng/ml; followed by starch = 12.1 ng/ml; and finally water plus fructose = 11.0 ng/ml.

Chromium Effects During Exercise

Strenuous exercise causes a several-fold increase in urinary chromium. Trained runners have lower basal chomium losses than untrained subjects.

Chromium Intake Low in Self-Selected Diets

Dietary chromium intake in adult male subjects in the Beltsville area is about 50% the suggested safe and adequate intake of 28 micrograms. At chromium intakes of less than 40ng/day, chromium absorption is inversely related to intake.

Chromium and Glucose Tolerance

Supplemental chromium leads to significant improvements in glucose tolerance in normal free-living individuals. Simple sugars stimulate chromium losses.

Vitamin B-6 Metabolism in Red Blood Cells

That red blood cells are more active biochemically in the metabolism of vitamin B-6 than previously thought was shown by giving single, high oral doses of pyridoxine to healthly male and female subjects. Subsequent plasma concentration of pyridoxal phosphate peaked 68 hours later but the red blood cell concentration peaked after only 30-45 minutes and was 20 times greater than that in plasma.

Microassay for Plasma Pyridoxal Phosphate

The assay procedure for plasma pyridoxal phosphate has been improved so that samples of only 10 microliters, rather than 850-1000 microliters are required. This modification now permits assays of plasma from premature infants (where the amount of plasma which may removed safely is extremely limited).

Difference Between Vitamin B-6 Metabolism in Normal and Asthmatic Adults

Response to a single pharmacologically dose of oral vitamin B-6 (pyridoxine) shows that asthmatics convert pyridoxine to pyridoxial phoophate at a slower rate than normal controls and that asthmatics have a pronounced lag in the conversion (which does not occur in normals).

Rapid automated Analyses of Water Soluble Vitamins

Extraction and high pressure liquid chromatographic (HPLC) procedure developed for thiamin have been applied to a number of foods. Another HPLC procedure was developed to separate ascorbic acid from isoacorbic acid and to quantify their amounts in foods.

Biotin in Adults

Biotin has a role in regulating fatty acid metabolism. Because our previous study showed that dietary biotin intake by males in self-selected diets was only 25 to 50% of the provisional RDA, we followed up with a second study to determine the effects of feeding physological levels of biotin on essential fatty acid metabolism. When analysis is complete, we hope to be able to better define biotin's role as well as obtain more precise information about the biotin requirement of adult males.

Human Plasma Response to Beta-carotene from Different Sources

Subjects fed single doses of beta-carotene or beta-carotene containing vegetables (carrots, broccoli or tomato juice) responded differently with regard to bioavailability of the beta-carotene from these different sources (i.e. mean plasma beta carotene 32 hours after ingestion). Purified beta carotene elicited the best response; carrot elicited the next best response, although there was a wide variation among individuals. Neither broccoli nor tomato juice elicited any increase in their corresponding carotenoids.

Carotenoids in Vegetables and Changes due to Cooking

Using several improved automated analytical methods, major carotenoids were separated and quantified from five green vegetables (broccoli, cabbage, spinach, brussel sprouts, and kale). The abundant carotenoids were lutein, neoxanthin, violaxanthen, lutein epoxide, and beta-carotene. Mono cis isomers of several of these caroteniods also were presents. The most abundant caroteniod in all vegetables was all-trans-lutein. Mild cooking (6 min. microwave) reduced total caroteniod content of brussels sprouts and kale 30-40%. Except for neocrome which increased, the other caroteniods decreased as a result of cooking.

New Standard for Caroteniod HPLC

An internal standard, C-45-beta-carotene, was synthesized and its applicability assessed for use in quantification of caroteniods.

Methods for Major Caroteniods in foods

High performance liquid chromatography methods were developed for separation, identification and quantification of individual caroteniods in green leafly and yellow-orange vegetables.

Analytical Methods for Sterols

Methods have been developed for quantifying esterified and nonesterified sterols (plants sterols as well a cholestrol) in lipid extracts of foods, and in fats and oils. Data management techniques and pattern recognition procedures were developed for the evaluation of large blocks of data.

Lactose and Vitamin D Absorption in Juvenile Jaundice

Because we showed that dietary lactose replaces vitamin D in experimental animal models, we supplemented diets of human infants with juvenile jaundice since these children have limited absorption of vitamin D. Dietary supplementation with 7-10% lactose increased serum calcium and phosphorus and decreased alkaline phosphatase. These data suggest the potential benefit of dietary lactose supplementation to children who (a) are <u>not</u> lactose sensitive and (b) have juvenile jaundice.

Different Effects Vitamins E in Men and Women

In people eating self selected diets, moderate vitamin E supplementation reduces HDL fluidity of women but not men. It is thought that vitamin E changes the organization of an HDL fraction in women, possibly affecting lipid transport by HDL.

Caution about "Omega-3" Polyunsaluated Fatty Acids

Coronary heart disease (CHD) causes more that 550,000 yearly deaths in the U.S. at a cost of over $60 billion a year. Evidence from the last several years of research indicates that mortality from CHD is inversely related to fish consumption. This effect has been attributed to "omega-3" polyunsaturated fatty acids (PUFA), primarily eicosapentaenoate (EPA) which is an important constituent of marine oil. Our work is an effort to help elucidate the biochemical mechanisms repsonsible for the beneficial effects of fish oil. In a pilot study, we found that dietary supplementation with a fish oil concentrate (MaxEPA) leads to the synthesis of prostaglandin E3 (PGE3) in the kidney. PGE3 is a hormone-like substance which metabolically derives from EPA. The physiological activity of PGE3 is largely unknown. Therefore, this new finding is an implicit warning against the uncontrolled use of marine oil concentrate by the general public because some of the biological consquence of such use may not be desirable. For instance, the antihypertensive function of the kidney inner medulla has been traced in part to its production of large quantities of PGE2, the production of which, presumable, is depressed as EPA is metabolized to PGE3.

Trans fatty Acids and Milk Fat

Dietary trans fatty acids depress the percent of fat in the milk of lactating mice. This effect can be partly reversed within four days of removing trans fatty acids from the diet.

Dietary Polyunsaturated Fats Affect Red Blood Cells

High levels dietary polyunsaturated acids fed to healthy, premenopausal women significantly increased their erythrocyte ghost membrane fluidity and insulin binding. Insulin receptor activity was dependent on membrane fluidity.

Diets High in Polyunsaturated Fats Effect Lipoprotein Fluidity in Women

In healthy premenopausal women both low density lypoprotein (LNL) and high density lypoprotein (HDL) were most fluid with diets low in fat (20% of energy) and high in polyunsaturates. Fluidities were related to lipoprotein linoeate levels only during the luteal period of the menstrual cycle therefore demonstrating hormonal effect on lipoprotein chemistry.

Control of Low Density Lipoprotein in Men

In men fluidity of LDL depends upon the phospholipid linoleate content of the LNL due to diet and is not under further controlled by hormones (as it is in premenstrual women).

New form of Lithocholic Acid

It is know that bile acids are key end products of cholesterol metabolism. We have discovered a new form of the toxic secondary bile acid, lithocholic acid covalently bound to certain proteins in liver.

New Rapid Test for Fecal Mutagens

We developed an adaptation of a new and rapid microbial test (called "SOS Chromotest") for quantitative evaluation of mutagenic substances in human stools. The method has been validated and concordance studies with the generally accepted Ames mutagenicily assay completed.

Trans fatty Acids in Tumor Cells: A New Cellular Model System

Investigation of the metabolism of trans-octadecenoates in a murine leydig tumor tissue culture showed that trans fatty acids are uniquely metabolized: they sometimes act like saturated fatty acids and other times like unsaturated components. Some positional isomers were enriched in all lipids whereas others tended to be excluded. Since these results are similar to those obtained with intact animals, this cell line shows promise as a convenient vehicle for studies on metabolism of trans fatty acids.

Improved Methods for Food Sugar, Starch, and Dietary Fiber

Separation and quantification were optimized of mixtures of products of hydrolysis of polysaccharides found in dietary fiber. Hydrolysis methods for pectin were improved to the extent that the yield of galacturonic and was doubled and hydrolysis time reduced from two hours to two minutes.

Biological Standard for Inorganic Constitutents

A large pool of bovine serum albumin was (BSA) collected by means which minimized contamination and the inorganic constituents determined by independent methods (in an international collaboration). The well-analysed BSA will become a biological standard, made available through the national Bureau of Standards.

Mixed Diet Reference Standard

A mixed diet reference standard was prepared from 200 foods from FDA's total Diet Study and now is available from the National Bureau of Standards as RM.-8431. Thus far the reference standard has been characterized for 17 elements. Further analyses for various trace and macro-nutrients and selected toxic elements are underway. This standard will be used in laborates in the United States and 15 collaborating countries.

Atomic Absorption Spectroscopy Improvements

A mathematical computer-applied method was developed for eliminating background correction errors for AA.

Energy Expenditure in Males

The energy expenditure of four male subjects was calculated from the decay rates of isotopes of D2 and 180 and changes in body composition. These energy expenditure calculation pointed out several potential problems with the D2180 method of measuring energy expenditure such as effect of total liquid consumption, consumption of beer during the measurements and the use of the intake balance method for validating the D2180 method.

Effect of Fiber Intake on Metabolizable Energy in Adult Men

The effect of level of fiber intake on metabolizable energy was studied in twelve adult men. Subjects consumed a diet of 25g neutral detergent fiber (NDF) from fruits and vegetables (Diets I) or 5g NDF (Diet II) for 6 weeks each in a cross over design. The metabolizable energy as a percent of the energy consumed for all four weeks for diet I (88.8+2.0 mean+SD) was significantly lower than for diet II (92.2+1.4); and the mean coefficients of availability for diets I and II, respectively, were 0.85 and 0.90 for protein, 0.96 and 0.97 for fat and 0.94 and 0.98 for carbohydrates. The metabolizable energy of these diets calculated from U.S. food tables overestimated the measured metabolizable energy by a mean of 5.5% (Diet I) and 4.3% (Diet II).

Improved Animal Whole Body Calorimeter

A whole body direct calorimetry system for animal model studies with dogs was modified to simulate our room-size human calorimetry system. These modification also were designed to increase accuracy and precision of measurements of heat production and to allow indirect calorimetry measurement to be made simultaneously with the direct system. Modifications included: gas composition analysis (02, C02, H20), air flow measurement and control, computerized data collection and processing.

Improved Analysis Methods for Animal Calorimeter Data

A computerized system for recording daily body water, daily food intake, periodic resting energy expenditure and periodic body composition data has been implemented.

Protein Diets and Collagen Effects in an Animal Model

Studies on the effect of high protein diets in growing and aging rats showed a marked difference in collagen crosslinking in growing rats fed diets continuing more than or less than adequate levels of protein. The effects of dietary protein level became insignificant as the animals aged, therefore it can not be stated positively that collagen crosslinking is an etiologic factor in age-associated osteoporosis.

Collagen Crosslinking in Humans with Osteoporosis

Collagen crosslinking in human subjects with osteoporosis was found to be altered relative to the degree of severity as assessed by clinical means. A more normal crosslink pattern can be seen in bone of subjects treated with adequate dietary calcium and anabolic steriods.

Body Composition in Women Consuming High and Low Fat Diets

Body composition was measured in women who consumed diets containing 40% and 20% of calories as fat for four months each. The mean subject percent fat on the low fat diet decreased by 0.8% as estimated by skinfolds and by 1.2% as estimated from total body impedance, suggesting that body fat stores are sensitive to nutrient composition.

Feasibility of Portable Near-Infrared Spectrometer for Body Composition

A computer simulation was performed to test the feasibility of developing a low cost, portable instrument using the principles of near-infrared spectroscopy for measuring human body composition. A correlation coeffecient of 0.93% was obtained when results from the computer simulation were regressed on results obtained from deuterium oxide dilution.

Continued Development of the Room Size of Human Calorimeter Facility

Support systems for the room sized calorimeter were developed and installed. These included the completion of the systems for the control of the temperature, humidity and flow rates of the air supplied to the chamber and the temperature and flow rates of the water that circulates through the external envelope of the calorimeter. Software for on-line monitoring and data collection was updated. The calorimeter was modified to allow food and biological specimens to be passed in and out of the chamber. Furniture was procured for the calorimeter to assure comfortable living conditions.

Microbical Assays for Amino Acid Availability

The potential problem of genetic reversion, observed in the use of *Escherichia coli* point mutants for amino acid availability assay, was solved by use of non-revertible mutants for estimating lysine, trytophan, threonine, methionine, and cystine bioavailability. *Streptococcus zymogenes* assays were used to assess methionine and tryptophan availabilities.

Immobilized Enzyme Bioreactors

Four bioreactors for implementing a mammalian enzyme based immobilized digestive enyzme assay were constructed. Two of the reactors contained pepsin as the immobilized enzyme while the other two contained chymotrypsin, trypsin and intestinal mucosa peptidases. The assay system was used to determine rates of nitrogen digestibility of 17 protein sources; values varied from less than 20% to over 100% of those for reference casein.

BELTSVILLE HUMAN NUTRITION RESEARCH CENTER

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